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XIV.—*On the Bats of the Family Megadermatidæ.*

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THE following notes are based on an examination of the material in the British Museum of Natural History.

Key to the Genera.

- A. Frontal shield of skull wider in front than behind. Cusp 2 of m^1 * much reduced in size or almost entirely disappeared. Antero-internal basal cusp of upper canines always distinct.
- a. p^2 † present. Prenasal notch of skull rounded posteriorly. (Oriental and Malayan.)
- a'. Prenasal notch of skull shallower, extending only to level of front of m^1 . Tragus longer, more slender. General size smaller 1. *Megaderma*.

* The three cusps forming the tips of the **W** of a typical molar in insectivorous bats are termed, in antero-posterior direction, respectively 1, 2, 3; the two cusps forming the base of the **W**, 4 and 5; the lingual "heel" of the upper molars, when single, 6, when double, 6 and 7: see Herluf Winge, "Om Pattedyrenes Tandskifte, især med Hensyn til Tændernes Former," in Vidensk. Meddel. Naturhist. Foren. Kbhvn. 1882, pp. 15-69, pl. iii. (We prefer Winge's designations to those proposed by Osborn, which, in our opinion, are based on an erroneous idea of the succession of the cusps, and give a mistaken interpretation of the cusps of the lower as compared with those of the upper molars.)

† The small anterior upper premolar.

- b'. Prenasal notch of skull deeper, extending to level of front of m^2 . Tragus shorter, broader. General size larger II. *Eucheira*.
- b. p^2 absent. Prenasal notch of skull pointed posteriorly. Tragus very short and broad. General size very large. (Australian.) III. *Macroderma*.
- B. Frontal shield of skull not wider in front than behind. Cusp 2 of m^1 not or scarcely reduced in size. p^2 absent. (Ethiopian.)
- a. Posterior pair of angles of frontal shield produced to form postorbital processes; upper surface of shield comparatively flat. m^1 quite normal. Antero-internal basal cusp of upper canines present. Nose-leaf very large. Tragus long, narrow. Pollex small IV. *Lavia*.
- b. Posterior pair of angles of frontal shield not produced to form postorbital processes; upper surface of shield strongly concave. Cusp 3 of m^1 moved backward. Antero-internal basal cusp of upper canines absent. Nose-leaf small. Tragus short, broad. Pollex larger. . V. *Cardioderma*.

I. MEGADERMA, Geoff.

1810. *Megaderma*, Geoffroy, Ann. Mus. d'Hist. Nat. xv. p. 187.

Diagnosis.—See "Key" above, p. 129.

Skull.—Frontal shield wider in front than behind, its anterior pair of angles situated at the bases of the maxillary processes of the zygomatic arches; the ridges joining them with the posterior pair of angles forming quite normal supra-orbital ridges; looked at from above, the anterior pair of angles are obscured by anteorbital swellings, which, separated by a distinct depression, occupy the whole anterior part of the frontal shield. Prenasal notch shallower, measured from the cingulum of canine equal to about $\frac{1}{6}$ of total length of skull.

Teeth.—A small p^2 present. Cusp 3 of m^1 is moved backward, while cusp 2 is moved inward and reduced in height. In the typical molar of an insectivorous bat the anterior and posterior triangles are practically of the same size; in *Megaderma* the posterior triangle (formed by cusps 2, 3, 5) is distinctly larger than the anterior (formed by cusps 1, 2, 4), though not to the same extent as in *Eucheira*. Antero-internal basal cusp of upper canines quite distinct, but not so strongly developed as in *Eucheira*.

Nose-leaf.—Posterior leaf in shape a broad ellipse, rather longer than the horseshoe, with a median longitudinal fold which, seen from the front, appears as a longitudinal ridge; at its base this ridge expands into a broad, heart-shaped, median leaf, which overlaps and conceals the lateral margins of the horseshoe.

Tragus.—Both lobes proportionally long and narrow, as compared with those of *Eucheira*.

Range.—From the Indian Peninsula and Ceylon eastward as far as the Philippines, Celebes, and Ternate.

Species.—Three, viz.: *M. spasma*, *M. carimatæ*, *M. natunæ*.

Nomenclature.—The name *Megaderma* was proposed by Geoffroy in 1810 (*l. s. c.*). The author describes the four species included by him in *Megaderma* in the following order:—*M. lyra*, *M. frons*, *M. trifolium*, *M. spasma*. But *M. spasma* is mentioned in the description of the genus in advance of all other species (“je me suis cru fondé à considérer le *V. spasma* et ses congénères comme formant un groupe isolé,” p. 190), and in a short summary (p. 197) which professes to give a view of the species in their proper order (“dans l’ordre de leurs rapports”) Geoffroy heads the list with *M. trifolium*, *i. e.* the western race of *M. spasma*. In accordance with the generally accepted view we therefore regard *M. spasma* as the type of the genus.

Key to the Forms.

- A. Size smaller: skull 25-27 mm.
 - a. Ears shorter: from crown 27.0-30.0 mm. 1. *M. spasma*.
 - a'*. Lower leg averaging shorter: 28-29.5 mm. 1*a*. *M. s. spasma*.
 - b'*. Lower leg averaging longer: 29.5-33.5 mm. 1*b*. *M. s. trifolium*.
 - b. Ears longer: from crown 31.4-35 mm. 2. *M. carimatæ*.
- B. Size larger: skull 28.5 mm. 3. *M. natunæ*.

1. *Megaderma spasma*, L.

Diagnosis.—Size in every respect smaller than in *M. natunæ*; ears shorter than in *M. carimatæ*.

Details.—Distinguishable at a glance from *M. natunæ* by the conspicuously smaller size, especially of the skull and teeth. Total length of skull to front of canines 25-27 mm., in *M. natunæ* 28.5 mm.; length of upper tooth-row (*c-m*³) 9.5-10.5 mm., in *M. natunæ* 11.4 mm.; forearm 53-62 mm., in *M. natunæ* 63 mm.* From *M. carimatæ* it differs only by its somewhat shorter ears.

Range.—The same as that of the genus.

Races.—Two, viz.: *M. spasma spasma*, *M. spasma trifolium*.

* We give in the letterpress a few principal dimensions only; a detailed comparative table of measurements will be found at the end of the paper (p. 144).

1 a. *Megaderma spasma spasma*, L.1734. *Glis volans Ternatanus*, Seba, Thesaur. p. 90, pl. lvi. fig. 1.1758. *Vespertilio spasma*, Linnæus, Syst. Nat. ed. x. p. 32.1810. *Megaderma spasma*, L.; Geoffroy, Ann. Mus. d'Hist. Nat. xv. p. 195.1843. *Megaderma philippinensis*, Waterhouse, P. Z. S. p. 69.*Diagnosis*.—Lower leg averaging shorter: 28–29·5 mm.*Specimens examined*.—6 (2 skins) and 6 skulls, from Celebes (3), Philippines (3).*Range*.—"Ternate," Celebes, Philippines.*Nomenclature*.—Linné's *Vespertilio spasma* was based on Seba's "*Glis volans Ternatanus*." Having had no specimens from Ternate for examination, we use the name *spasma* for the race here under consideration, the habitat of which is the nearest to Ternate. Waterhouse described *M. philippinensis* from specimens collected by Cuming, some of which are now in the British Museum Collection. They are in every respect indistinguishable from Celebes individuals.1 b. *Megaderma spasma trifolium*, Geoff.1810. *Megaderma trifolium*, Geoffroy, Ann. Mus. d'Hist. Nat. xv. p. 193.1851. *Megaderma* —, Horsfield, Cat. Mamm. Mus. E. I. Co. p. 32.1863. *Megaderma Horsfieldi*, Blyth, Cat. Mamm. Mus. As. Soc. Beng. p. 23.*Diagnosis*.—Lower leg averaging longer: 29·5–33·5 mm.*Details*.—*M. s. trifolium* can only be distinguished from *M. s. spasma* by its rather longer lower leg. The skull, teeth, and external characters are otherwise the same in the two races.*Specimens examined*.—29 (16 skins) and 29 skulls, from Ceylon (3), W. India (4), Siam and Cochin China (8), Penang (2), Singapore (3), Sumatra (2), Java (6), Borneo (1).*Geoffroy's M. trifolium*.—Type locality: Java. Geoffroy compared his Javan bat with Seba's plate of *Glis volans Ternatanus* (Linné's *V. spasma*), and found it to differ in the shapes of the posterior leaf and the tragus; he therefore described it as a new species, *M. trifolium*. We have examined specimens from Java and can find no validity in these alleged characters. The name *trifolium* is the earliest available for the form here under consideration.*Blyth's M. Horsfieldi*.—In 1851 (*l. s. c.*) Horsfield described a *Megaderma* "from Continental India, contributed by E. Blyth, Esq., on behalf of the Asiatic Society of Bengal"; no name was proposed by Horsfield; it was characterized by

the absence of "transverse lines" from the membrane along the sides of the abdomen, and the presence of "regularly parallel ridges at the base of the ear." The British Museum possesses a specimen (skin, no. 60. 5. 4. 13), received from the India House Collection, which is in all probability the actual individual referred to by Horsfield; the peculiarities emphasized by him are partly due to bad preparation of the specimen and partly are quite individual. In 1863 (*l. s. c.*) Blyth proposed the name *Horsfieldi* for the species described but left unnamed by Horsfield. When the late Dr. J. Anderson (Cat. Mamm. Ind. Mus. p. 21, 1881) registered as "types" of *M. Horsfieldi* two specimens obtained by Mr. Theobald in Tenasserim he was undoubtedly in error. Blyth's *M. Horsfieldi* was, as already pointed out, based on Horsfield's "*Megaderma* ——" from Continental India.

2. *Megaderma carimatæ*, Miller.

1906. *Megaderma carimatæ*, Gerrit S. Miller, Jun., Proc. U.S. Nat. Mus. xxxi. no. 1481, p. 65.

The species is known to us only from the published account. Type locality: Karimata Island. According to Miller, it differs from *M. spasma* only in the smaller size and larger ears. The former character must be dropped: Miller gives as length of the forearm (five males and four females) 53.6–58.6 mm., as against 57–61 mm. in *M. spasma* (seven females, Malay Peninsula, *i. e.* *M. s. trifolium* of the present paper): but, first, Miller has compared his *M. carimatæ* with females only of *M. spasma*, and females of this species average larger than males; second, we find in twenty-nine individuals of *M. s. trifolium* the forearm varying between 53 and 62 mm. There remains the alleged greater length of the ears in *M. carimatæ*: measured from the crown "31.4–35 mm." (Miller) against "27–29 mm." (Miller) in *M. spasma*; we find that similar measurements for *M. s. trifolium* range from 27–30 mm. (Malay specimens 28–29 mm.).

3. *Megaderma natunæ*, sp. n.

Diagnosis.—In every respect larger than *M. spasma*.

Details.—The differences between *M. natunæ* and *M. spasma* have been pointed out above under the latter species (p. 131).

Type.—♂ ad. (in alc.). Bungaran Island, N. Natunas. Collected by A. Everett, Esq. British Museum no. 94. 9. 28. 30.

Range.—As yet known from the type specimen only.

II. EUCHEIRA, Hodgs.

1847. *Eucheira*, Hodgson, J. A. S. B. xvi. p. 891, footnote (September 1847).

1872. *Lyroderma*, Peters, MB. Akad. Berl. p. 195 (18th March, 1872).

Diagnosis.—See "Key," above, p. 130.

Skull.—Frontal shield as in *Megaderma*. Prenasal notch deeper, measured from the cingulum of canine about $\frac{1}{2}$ of total length of skull.

Teeth.—A small p^2 present. Cusp 3 of m^1 moved considerably backward; the posterior triangle (formed by cusps 2, 3, 5) at least double the size of the anterior (formed by cusps 1, 2, 4). Cusp 2 moved inward and tending to disappear, being represented only by a small tubercle, much below the level of the other cusps. Antero-internal basal cusp of upper canine very strongly developed, more so than in *Megaderma*.

Nose-leaf.—Posterior leaf a rectangle, with slightly convex sides, twice as long as the median leaf; median longitudinal ridge (fold) as in *Megaderma*, but its junction with median leaf forming an obtuse angle on each side, strongly contrasting with the sharply acute angles formed in *Megaderma*.

Range.—Indian Peninsula; S. China; there seems as yet to be no record of this genus from Burma.

Species.—Two, viz.: *E. lyra*, *E. sineusis*.

Hodgson's Eucheira.—Type species, *E. schistacea*, Hodgs., = *Megaderma lyra*, Geoff. The generic name *Eucheira* was proposed by Hodgson because the "phalangeal system [of *E. schistacea*] is apparently irreconcilable with Cuvier's general and Geoffroy's particular definitions" of the common structure of the wing in Chiroptera; but at the same time the description and figure of the wing of *schistacea*, as given by Hodgson himself, are those of a quite normal Megadermine wing, and his *schistacea* is undoubtedly nothing but the well-known "*Megaderma lyra*. Although, therefore, the whole basis on which Hodgson founded the genus *Eucheira* is a mistake, still the name, as being the earliest in date, will have to stand according to the current nomenclatural rules. The name *Eucheira* has apparently been overlooked by succeeding writers and is not mentioned in Palmer's 'Index Generum Mammalium.'

Peters' Lyroderma.—Type species, *Megaderma lyra*, Geoff. The characters given by Peters for the "subgenus" *Lyroderma* are the shape of the nose-leaf, the flatness of the frontal shield, and the absence of postorbital processes. The name *Lyroderma* is antedated by Hodgson's *Eucheira*.

Key to the Forms.

- | | |
|--|-----------------------------|
| A. Skull smaller: 27·8-29 mm.; prenasal notch posteriorly wider, flattened | 1. <i>E. lyra</i> . |
| a. On the average larger: forearm 65-69 mm..... | 1 a. <i>E. l. lyra</i> . |
| b. On the average smaller: forearm 63-68 mm. .. | 1 b. <i>E. l. caurina</i> . |
| B. Skull larger: 29·3-32 mm.; prenasal notch narrower, rounded posteriorly | 2. <i>E. sinensis</i> . |

1. *Eucheira lyra*, Geoff.

Chief characters.—Skull and teeth markedly smaller than in *E. sinensis*. Total length of skull 27·8-29 mm., in *E. sinensis* 29·3-32 mm.; upper tooth-row 10·8-11·5 mm., in *E. sinensis* 11·5-12·1 mm. Prenasal notch proportionally rather shorter, wider behind, posterior margin flattened.

Range.—Indian Peninsula.

Races.—Two: *E. lyra lyra* and *E. lyra caurina*.

1 a. *Eucheira lyra lyra*, Geoff.

1810. *Megaderma lyra*, Geoffroy, Ann. Mus. d'Hist. Nat. xv. p. 190.
 1839. *Vespertilio* (*Megaderma*) *caruatica*, Elliot, Madr. Journ. vol. x. p. 96.
 1844. *Megaderma spectrum*, Wagner, in Hügel's *Kaschmir*, iv. p. 569.
 1847. *E. schistacea*, Hodgson, J. A. S. B. xvi. p. 859.

Characters.—The present race can only be distinguished from *E. l. caurina* by average characters: skull 29-29·5 mm., upper tooth-row 11·1-11·5, forearm 65-69, against 27·8-28·3, 10·8-11, 63-64 respectively in *E. l. caurina*.

Specimens examined.—18 (16 skins) and 20 skulls, viz.: "Madras" (11), Secunderabad (1), Bengal (6).

Range.—Indian Peninsula, east of 75° E.

Geoffroy's Megaderma lyra.—Type locality: one of the Dutch factories in India, probably East Coast of Madras. Geoffroy separated *lyra* as a distinct species on account of the shape and size of the nose-leaf ("Feuille rectangulaire, la follicule de moitié plus petite," *l. s. c.*).

Elliot's Megaderma caruatica.—Type locality: Southern Maratha Country. Elliot relied on the presence of only three teeth in the upper row behind the canine to justify the separation of *caruatica*, but he seems himself to have been in doubt as to the validity of the species, inasmuch as he added "M. lyra?" The British Museum has several specimens collected by Elliot, all of them unquestionably *lyra*.

Hodgson's Eucheira schistacea.—Type locality: Siligori, N.E. Bengal. Hodgson left Nepal for good in 1844, and the context (*l. s. c.*) shows that he had never seen any species

of the family Megadermatidæ until he obtained the examples on which he based *schistacea*; these specimens, when later on acquired by the British Museum, were wrongly labelled "Nepal" (see Scully, J. A. S. B. lvi. pt. ii. no. 3, p. 234, 1887). Hodgson's specimens, as well as his published figure of the bat, show that *schistacea* is nothing but *E. lyra lyra*.

Wagner's Megaderma spectrum.—Type locality: Kashmir. Apparently based on a single specimen (Baron Hügel's collections). According to Wagner, *M. spectrum* has only four teeth behind the upper canine (*i. e.* one premolar only): but bearing in mind that p^2 is present in *all* known Oriental representatives of the family Megadermatidæ (this small tooth is wanting only in the Ethiopian genera *Lavia* and *Cardioderma* and the Australian *Macroderma*); further, that Wagner's description of *M. spectrum* is based throughout on a comparison with *M. frons* (*Lavia frons*), not with *E. lyra*, with which last he seems to have been unacquainted; again, that p^2 , when present in bats of this family, is extremely small, hidden on the *internal* side of the tooth-row, and therefore very easily overlooked when not searched for; and, finally, that Wagner's figure of *M. spectrum* differs in no appreciable respect from an ordinary *E. lyra*—there can be no reasonable doubt that Wagner's statement as to the number of teeth was wrong; if so, the whole basis of the supposed new species breaks down.

1 b. *Eucheira lyra caurina*, subsp. n.

Characters.—See above, under *E. l. lyra* (p. 135).

Specimens examined.—8 skins and skulls, all from the West Coast of India.

Type.—♀ ad. skin. Surat District, W. India. Collected by R. C. Wroughton, Esq. B.M. no. 98. 4. 2. 2.

Range.—India, west of 77° E.

2. *Eucheira sinensis*, sp. n.

Characters.—Size somewhat larger than *E. lyra*; see comparative measurements under that species above (p. 135). Prenasal notch proportionally rather longer, narrowed behind, posterior margin rounded.

Specimens examined.—2 skins and skulls, viz. Swatow (1), Amoy (1).

Type.—Adult (unsexed), skin and skull. Amoy, S. China. Tomes Collection. B.M. no. 7. 1. 1. 339.

Range.—S. China.

III. MACRODERMA, Miller.

1906. *Macroderma*, Gerrit S. Miller, Jun., Proc. Biol. Soc. Wash. xix. p. 84 (4th June, 1906).

Diagnosis.—See "Key," p. 130.

Skull.—Frontal shield wider in front than behind; its anterior angles raised into the same plane as the posterior (in the two preceding genera the anterior angles are depressed to the bases of the maxillary processes of the zygomatic arches); anteorbital swellings obliterated (distinct in *Megaderma* and *Eucheira*); as a consequence of these modifications the whole area of the pentagonal frontal shield flat and all its angles sharply and strongly defined. Prenasal notch still longer than in *Eucheira* (measured from cingulum of canines about $\frac{1}{4}$ of total length of skull); posteriorly pointed, not rounded or flattened as in *Megaderma* and *Eucheira*.

Teeth.— p^2 absent. Cusp 3 of m^1 moved backward as in *Eucheira*; cusp 2 moved inward to a line between cusps 1 and 5, almost obliterated; cusp 4 much reduced, markedly below the level of the remaining cusps. Antero-internal basal cusp of upper canines strongly developed.

Nose-leaf.—Posterior leaf ovoid as in *Megaderma*, double the length of the median leaf as in *Eucheira*; median leaf shaped as in *Eucheira*. Front margin of horseshoe plicate, suggesting a rudimentary form of the much more complicated structure in *Lavia*.

Tragus.—Both lobes short and broad, even more so than in *Eucheira*.

Range.—Central Queensland.

Species.—One, viz. *M. gigas*.

Nomenclature.—The genus *Macroderma* was established by Miller (*l. s. c.*) for *Megaderma gigas* and characterized by the absence of p^2 , the shape of the frontal shield, and the much greater development of the cartilaginous premaxillaries.

Macroderma gigas, Dobs.

1880. *Megaderma gigas*, Dobson, P. Z. S. p. 461, pl. xlvi.

Diagnosis.—Forearm 103–104 mm.

Specimens examined.—2 (1 skin) and 2 skulls, from Central Queensland.

Range.—As yet known only from Central Queensland.

IV. LAVIA, Gray.

1838. *Lavia*, Gray, Mag. Zool. Bot. ii. p. 490.

Diagnosis.—See "Key," p. 130.

Skull.—Frontal shield parallel-sided, but appearing wider behind, owing to development of the posterior pair of angles into long processes; otherwise as in *Macroderma*. Prenasal notch about the same proportional length as in *Eucheira*, showing a tendency to become pointed behind in some individuals (compare *Macroderma*).

Teeth.— p^2 absent. All five cusps of m^1 equally developed and placed in a regular W. Antero-internal basal cusp of upper canine about as in *Megaderma*.

Nose-leaf.—Posterior leaf in shape a long triangle, with slightly convex sides and truncated apex, three times as long as the median leaf; median longitudinal fold gradually widening anteriorly, the junction with the median leaf forming no appreciable angle on each side; median leaf small, with a lobe on each side anteriorly which reaches to the margin of the horseshoe and covers the nostrils; horseshoe with a notch on each side in front, between which the front margin of the horseshoe is produced into a free lobe; the sides of this lobe folded together downward, and then the whole turned backward to lie on the face of the median leaf.

Tragus.—External lobe very long.

Range.—W. Coast of Africa, from Cape Verd to the mouth of the Niger; Upper Nile Valley; Uganda; British and German East Africa.

Species.—One, viz. *Lavia frons*.

Nomenclature.—Type species of the genus, *Megaderma frons*, Geoff. Gray proposed the generic name *Lavia* on account of the shape of the nose-leaf and frontal shield and the absence of p^2 .

1. *Lavia frons*, Geoff.

Characters and Range.—Those of the genus.

Races.—Two, viz. *Lavia frons frons* and *Lavia frons affinis*.

1 a. *Lavia frons frons*, Geoff.

1759. *La Feuille*, Daubenton, Mém. Acad. Sci. Paris, p. 388.

1800. ? *Vespertilio megalotis*, Bechstein, in Pennant's Uebersicht der vierfüss. Thiere, p. 622.

1810. *Megaderma frons*, Geoffroy, Ann. Mus. d'Hist. Nat. xv. p. 192.

1905. *Lavia rex*, Gerrit S. Miller, Jun., Proc. Biol. Soc. Wash. xviii. p. 227 (9th December, 1905).

Diagnosis.—Average size larger.

Details.—Can only be discriminated from *L. f. affinis* by average characters: forearm 56–62 mm., skull 24.5–26, upper tooth-row 9–10, as against 52–58 mm., 23.5–24, 8.7–9 respectively in *L. f. affinis*.

Specimens examined.—33 (21 skins) and 23 skulls, viz. Gambia (6), Kumasi (1), N. Nigeria (2), Kordofan (4), Ruwenzori (4), Uganda (6), British East Africa (10).

Range.—The same as that of the genus (above, p. 138), with the exception of Bahr-el-Ghazal.

Bechstein's V. megalotis.—Under the name *V. megalotis* Bechstein describes a bat taken by Levaillant in Great Namaqualand, which, from the absence of the tail and the presence of nose-leaf and tragus, was clearly a member of the family Megadermatidæ. But no species has in recent times been recorded from Africa south of 15° S., and the measurements quoted by Bechstein are so strange (rendered from German inches into millimetres: nose-leaf 35 mm.; body 78 mm.; ear 70 (!) mm.; expanse 210 mm.) that it appears safer to leave Levaillant's bat unidentified.

Geoffroy's Megaderma frons.—Type locality: Senegal. Geoffroy's description is based, not on actual specimens, but on Daubenton's description of "La Feuille" (*l. s. c.*), which is undoubtedly the species here under consideration, being a bat with an ovate nose-leaf, "posé verticalement, qui ressemble à une feuille," "huit lignes de longueur sur six de largeur," with the ears "près de deux fois aussi grandes que la membrane" [*i. e.* the nose-leaf], and united "par la moitié de la longueur de leur bord interne," with a long, narrow, pointed tragus, with no tail, with the fur "d'une belle couleur cendrée, avec quelque teinte de jaunâtre," with $\frac{9}{2}$ incisors, $\frac{3}{2}$ cheek-teeth, and inhabiting Senegal.

Miller's Lavia rex.—Type locality: Taveta, German East Africa. Miller relies for the discrimination of *L. rex* on its greater external dimensions, longer mandible, and heavier teeth: "forearm 60 mm.," "mandible 17.8," "maxillary tooth-row 9.2," instead of "56 mm.," "15.2" mm., and "8.2 mm." respectively in *L. frons*. These measurements, as well as all the others given by Miller, place it beyond doubt that his *L. rex* is *L. frons frons* and that the reason for his describing it as new was that he compared it, not with the true *L. frons frons*, but with the smaller race described in this paper as *L. frons affinis*.

1 b. *Lavia frons affinis*, subsp. n.

Diagnosis.—Average size smaller.

Details.—Comparative measurements are given above under *L. frons frons* (p. 139).

Type.—♂ ad. skin. Kaka, White Nile. Collected by R. M. Hawker, Esq. B.M. no. 1. S. S. 3.

Specimens examined.—8 (7 skins) and 6 skulls, viz. White Nile (5), Lake No (1), Lado (1), Wadelai (1).

The British Museum possesses a somewhat damaged skull without skin from Cape Coast Castle (Gold Coast) which seems to belong to this race, and Miller's specimen of "*L. frons*" referred to above under *L. f. frons* (p. 139) appears also to belong to the present race; so it is possible that the range of *affinis* extends westward to the coast.

V. CARDIODERMA, Peters.

1873. *Cardioderma*, Peters, MB. Akad. Berlin, p. 488 (23rd June, 1873).

Diagnosis.—See "Key," p. 130.

Skull.—Frontal shield parallel-sided; the centre longitudinally depressed, so as to form a "trough"; all the angles sharply defined, but not produced into processes as in *Lavia*. Prenasal notch about as long as in *Megaderma* ($\frac{1}{6}$ total length of skull), flatly rounded posteriorly.

Teeth.— p^2 absent. Cusp 3 of m^1 about as in *Megaderma*. Antero-internal basal cusp of upper canine absent.

Nose-leaf.—As in *Megaderma*, but a distinct trace of antero-lateral lobes of the median leaf, as in *Lavia*; in *Megaderma*, *Eucheira*, and *Macroderma* these lobes are merely indicated by faint depressions in the margin of the median leaf.

Tragus.—Both lobes very short; the inner flatly rounded at top and excavate at the base in front, so that it seems directed inward rather than upward.

Range.—East Africa: Zanzibar, Mombasa, Somali.

Species.—One, *C. cor*.

Nomenclature.—Type species of the genus, *Megaderma cor*. In 1872 Peters described *Megaderma cor*, and in the following year proposed for this species the subgeneric name *Cardioderma* without any further characterization.

Cardioderma cor, Ptrs.

1872. *Megaderma cor*, Peters, MB. Akad. Berl. (18th March, 1872) p. 194.

Specimens examined.—10 (3 skins) and 8 skulls, viz. Zanzibar (2), Mombasa (2), Somali (6).

Peters' Megaderma cor.—Type locality: Abyssinia. Peters based his diagnosis of *Megaderma cor* on the shape and size of the nose-leaf and tragus.

Wing-structure.

The four families Nycteridæ, Megadermatidæ, Hipposideridæ, and Rhinolophidæ are rather closely inter-related; they have probably had a common origin. When trying to form an idea of the stage of development at which the wing-structure of the Megadermatidæ has arrived, it is therefore fair to compare them with such species of the other families as have, in this respect, remained on a low level, f. i. *Hipposiderus diadema*.

In *H. diadema* the third metacarpal is the longest, the fifth the shortest, the indices of the third, fourth, and fifth metacarpals being, respectively, 716, 696, and 640; that this is a primitive condition needs hardly any comment (a similar mutual length of the metacarpals is found in many primitive fruit-bats). In the Megadermatidæ the third metacarpal is the shortest, the fifth the longest, the indices being 727, 784, and 845; the third metacarpal, it will be noticed, has retained practically the same length (727) in proportion to the forearm as in *H. diadema* (716), whereas the fourth and, still more, the fifth have been very considerably lengthened.

In *H. diadema* the first phalanx of the third digit (index: 329) is somewhat less than half the length of the third metacarpal (716); in the Megadermatidæ it is decidedly lengthened (index: 404), being always more than one half of the metacarpal (727). The first phalanx of the fourth digit has retained the same length in proportion to the forearm as in *H. diadema* (242 against 237); the first phalanx of the fifth digit is slightly lengthened (280 against 247).

In *H. diadema* the second phalanx of the third digit (327) is only equal in length to the first phalanx (329); in the Megadermatidæ it is enormously lengthened (693), being almost $\frac{7}{4}$ of the first phalanx (404). In *H. diadema* the distal phalanges of the fourth and fifth digits are considerably shorter than the proximal phalanges; in the Megadermatidæ the second phalanx of the fourth digit is at least equal to

Wing-indices.

| | Forearm. | 3rd digit. | | | | 4th digit. | | | | 5th digit. | | | | | | |
|---|----------|------------|---------|-----|---------|------------|------|---------|-----|------------|--|------|---------|--|---------|--|
| | | Mtc. | 1st ph. | | 2nd ph. | | Mtc. | 1st ph. | | 2nd ph. | | Mtc. | 1st ph. | | 2nd ph. | |
| | | | | | | | | | | | | | | | | |
| <i>Megaderma</i> (36 spems.) | 1000 | 745 | 384 | 661 | 807 | 231 | 320 | 856 | 288 | 270 | | | | | | |
| <i>Eucheira</i> (27 spems.) | 1000 | 731 | 420 | 688 | 791 | 244 | 308 | 869 | 282 | 261 | | | | | | |
| <i>Macroderma</i> (2 spems.) | 1000 | 710 | 435 | 712 | 773 | 250 | 246 | 820 | 329 | 217 | | | | | | |
| <i>Lavia</i> (41 spems.) | 1000 | 728 | 412 | 723 | 756 | 261 | 261 | 825 | 276 | 285 | | | | | | |
| <i>Cardioderma</i> (10 spems.)..... | 1000 | 711 | 368 | 669 | 760 | 224 | 334 | 844 | 245 | 289 | | | | | | |
| <i>Megadermatidae</i> (116 spems.) | 1000 | 727 | 404 | 693 | 784 | 242 | 277 | 845 | 280 | 279 | | | | | | |
| <i>Hyposiderus diadema, lankadiva, evotis, dinops</i> (37 spems.) | 1000 | 716 | 329 | 327 | 696 | 237 | 173 | 640 | 247 | 194 | | | | | | |

(*Macroderma*, *Lavia*), but often much longer than (*Megaderma*, *Eucheira*, *Cardioderma*), the first phalanx; the second phalanx of the fifth digit is in all genera of *Megadermatidae* approximately equal to, or rather longer than, the

first phalanx, except in *Macroderma*, in which it has remained rather short.

The total result of these modifications is best realized by a comparison of the total index of the third, fourth, and fifth digits: in Megadermatidæ 1824, 1303, and 1404, as against 1372, 1106, and 1081 in *H. diadema* and allied species. The greatest increase (452) falls on the third digit, the next (323) on the fifth, the smallest (197) on the fourth; *i. e.* the area of the wing in the family Megadermatidæ is enormously increased in size, the wing being at the same time much more pointed (lengthening of third digit in proportion to fourth) and much broader (lengthening of fifth digit in proportion to fourth).

General Remarks.

The five genera of Megadermatidæ are referable to two fundamental types. In the one, represented by *Megaderma*, *Eucheira*, and *Macroderma*, the frontal shield of the skull is but moderately developed, the median external cusp (cusp 2) of the upper m^1 is more or less on the point of disappearance, and, with the exception of the somewhat aberrant *Macroderma*, they have preserved the small anterior upper premolar (p^2). In the other group, represented by *Lavia* and *Cardioderma*, the frontal shield is largely developed, giving the skull a quite peculiar aspect, the median external cusp of the upper m^1 is of normal (or almost normal) size and p^2 has completely disappeared. The former group is Oriental, Malayan, and Australian, the latter Ethiopian.

Megaderma and *Eucheira*, from the Malay Archipelago and S. Asia, are very closely related, differing in no other important respects than the *degree* of modification of the cusps of the upper molars, the size of the prenasal notch, and the size and shape of the tragus. In having cusp 2 of m^1 still more reduced in size, cusp 3 still more posterior in position, and the prenasal notch still deeper, the strictly continental *Eucheira* is clearly on a higher level of development than the Malayan and continental *Megaderma*.

The Australian *Macroderma* is undoubtedly an offshoot of the *Megaderma-Eucheira* branch; broadly speaking, it accords with these latter genera in the general shape of the frontal shield, the strong reduction of cusp 2 of m^1 , and the posterior position of cusp 3 of m^1 , but it has completely lost p^2 , and the prenasal notch is unusually deep and different in shape.

The two Ethiopian genera *Lavia* and *Cardioderma*, forming the second section of the family, are closely related *inter se*.

Lavia is the more primitive: the frontal shield is not so profoundly modified as in *Cardioderma*, m^1 is quite normal in structure. In *Cardioderma* the frontal shield attains its highest degree of modification, the posterior of the external cusps (cusp 3) of m^1 is moved somewhat backward, and the antero-internal basal cusp of the upper canines, present in all other genera, has quite disappeared.

Summary.—Selecting the most primitive of the cranial and dental characters preserved in the five living genera of Megadermatidæ, we are able to draw up a rough sketch of the skull and teeth of the unknown prototype of the family. It was a bat with the frontal shield not very considerably different from that of *Megaderma* and *Eucheira*, with the five primary cusps of m^1 practically of equal size, as in the typical molar of an insectivorous bat, and with a small p^2 . From this type of bat originated, on the one side the Malayan and Oriental *Megaderma* and *Eucheira*: frontal shield not largely modified, p^2 preserved, but cusp 2 of m^1 more or less reduced, cusp 3 more or less moved backward; and the Australian *Macroderma*: essentially as *Megaderma* and *Eucheira*, but p^2 lost; on the other side the Ethiopian *Lavia* and *Cardioderma*: molar cusps almost normal, but frontal shield profoundly modified, and p^2 lost.

The subjoined diagram gives a view of probable inter-relations and phylogeny of the genera:—

